Unpackers in a World of Signature-less Malware Detection

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INTRODUCTION

Approaches to Detection

Signature based

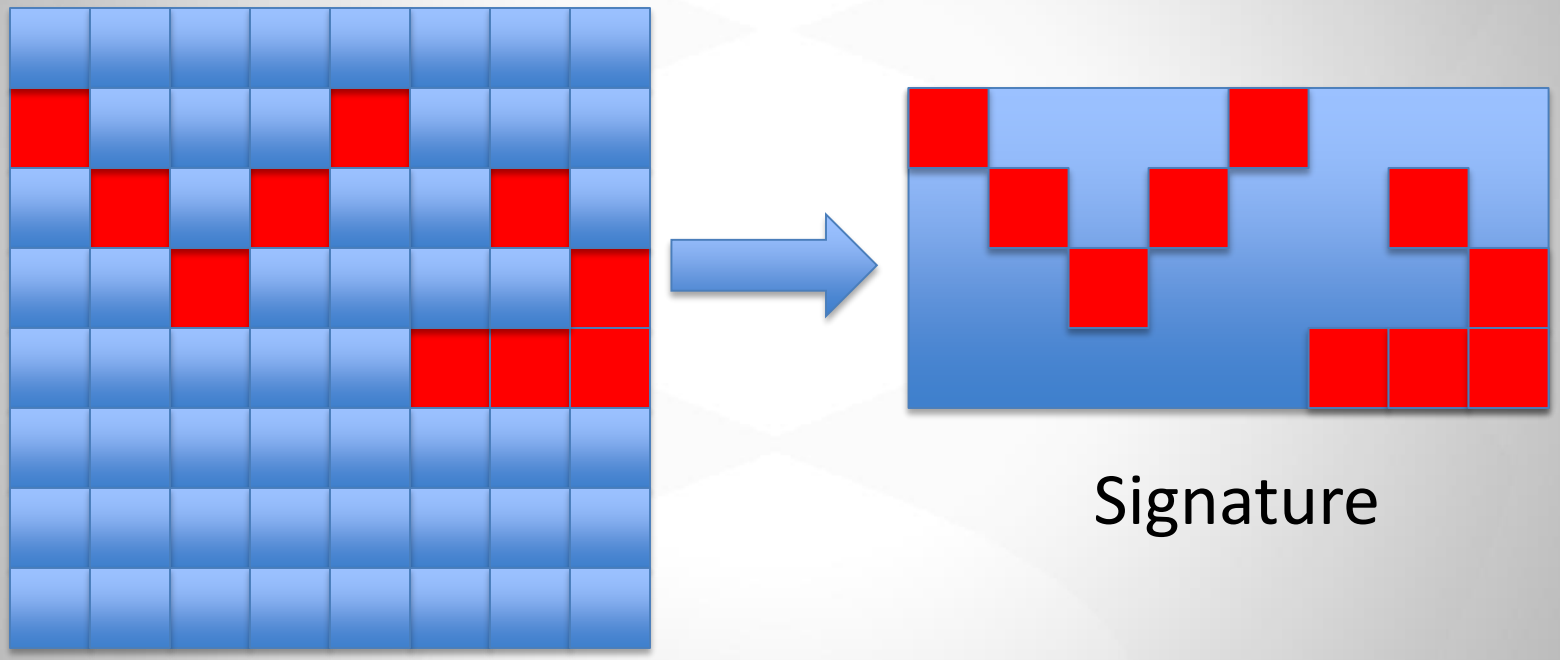
Anomaly based

Hybrid

Behaviour based

Specification based

Signature Based Detection

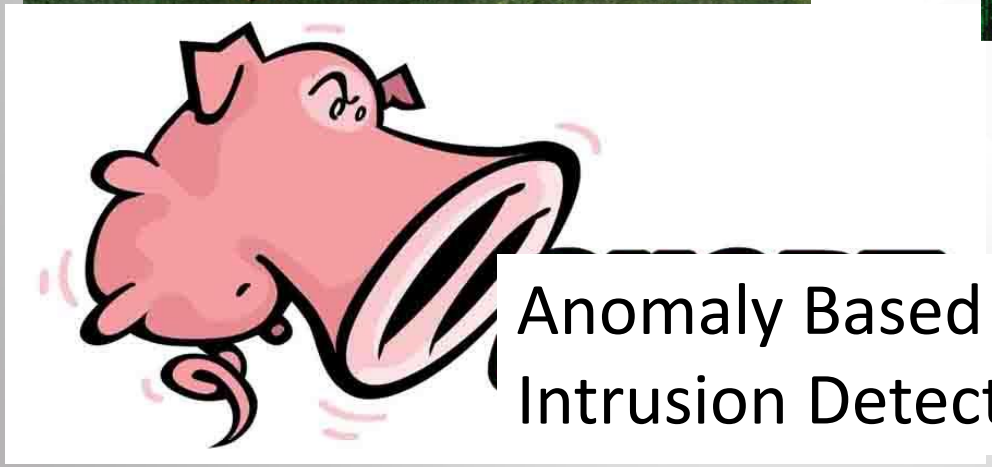


Application

Signature-less Based Detection

Sandbox Software

Virtualization Engine



Anomaly Based
Intrusion Detection System

Next Generation Anti-Virus (NGAV)

1. Automated static analysis
2. Dynamic analysis through emulation
3. Dynamic analysis through virtualization
4. Dynamic analysis through bare-metal (non VM)

Competition of NGAVs

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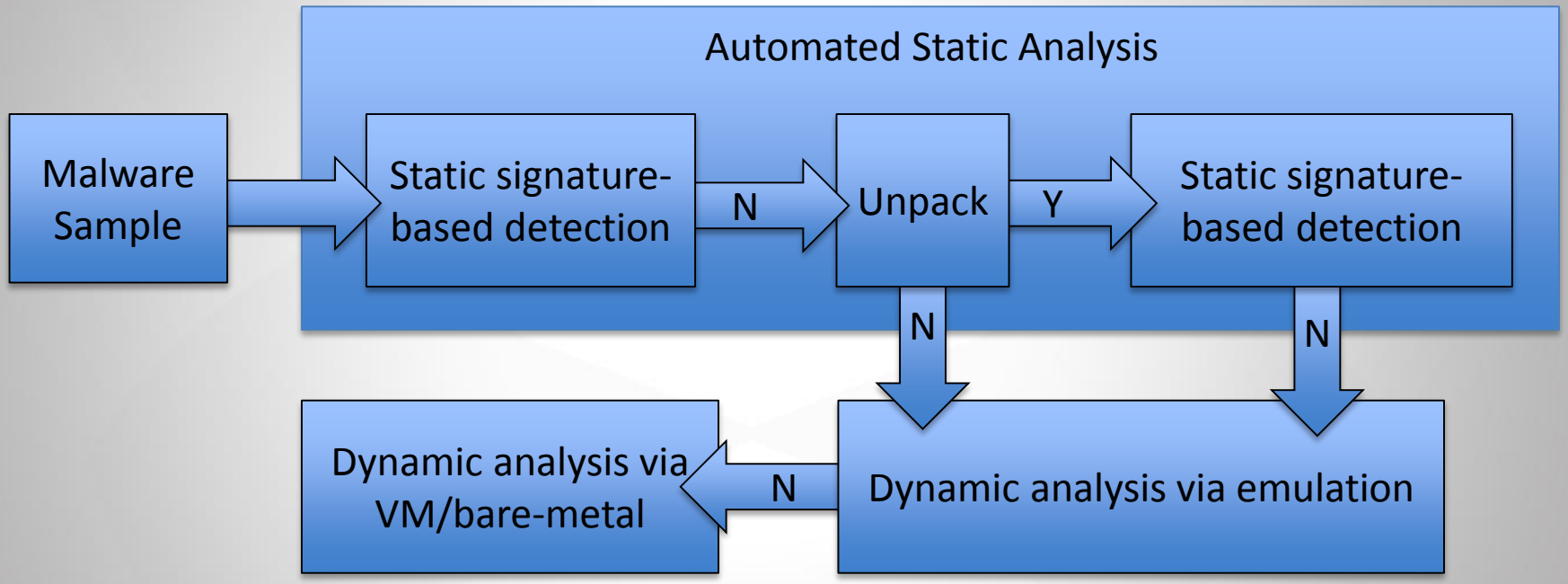
NGAV Process



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Unpackers In Next Gen AV

Pros

1. Augments existing detection.
2. Helps reduce processing files for dynamic analysis.
3. Provide faster scan time.

Cons

1. No use for APT or 0-day malware.
2. Applicable only to PE file format.

THE WINDOWS EXECUTABLE FORMAT

The EXE File

Assembly Code

```
ing 32-bit PE program as raw
format PE GUI
entry start

section '.text' code readable executable
 start:
    push    0
    push    _caption
    push    _message
    push    0
    call    [MessageBoxA]
    push    0
    call    [ExitProcess]

section '.data' data readable writeable
 _caption db 'Win32 assembly program',0
 _message db 'Hello World!',0
```

Compiled Binary

```
.00401000: 6A00          push    0
.00401002: 6800204000    push    000402000 ;'Win32 assembly program' --□1
.00401007: 6817204000    push    000402017 ;'Hello World!' --□2
.0040100C: 6A00          push    0
.0040100E: FF1544304000  call    MessageBoxA
.00401014: 6A00          push    0
.00401016: FF153C304000  call    ExitProcess
.0040101C: 0000          add     [eax],al
.0040101E: 0000          add     [eax],al
.00401020: 0000          add     [eax],al
.00401022: 0000          add     [eax],al
```

Equivalent C Pseudo code

```
MessageBoxA (0, "Hello World!", "Win32 assembly program", 0);
ExitProcess (0);
```

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The EXE File

Memory Address | Hex Code | Disassembly

```
.00401000:  6A00          push    0
.00401002:  6800204000    push    000402000 ;'Win32 assembly program' --□1
.00401007:  6817204000    push    000402017 ;'Hello World!' --□2
.0040100C:  6A00          push    0
.0040100E:  FF1544304000  call    MessageBoxA
.00401014:  6A00          push    0
.00401016:  FF153C304000  call    ExitProcess
.0040101C:  0000          add     [eax],al
.0040101E:  0000          add     [eax],al
.00401020:  0000          add     [eax],al
.00401022:  0000          add     [eax],al
```

```
.00401000:  6A 00 68 00-20 40 00 68-17 20 40 00-6A 00 FF 15
.00401010:  44 30 40 00-6A 00 FF 15-3C 30 40 00-00 00 00 00
.00401020:  00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
```

CODE Section

```
.00402000:  57 69 6E 33-32 20 61 73-73 65 6D 62-6C 79 20 70   Win32 assembly p
.00402010:  72 6F 67 72-61 6D 00 48-65 6C 6C 6F-20 57 6F 72   rogram Hello Wor
.00402020:  6C 64 21 00-00 00 00 00-00 00 00 00-00 00 00 00   ld!
.00402030:  00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
```

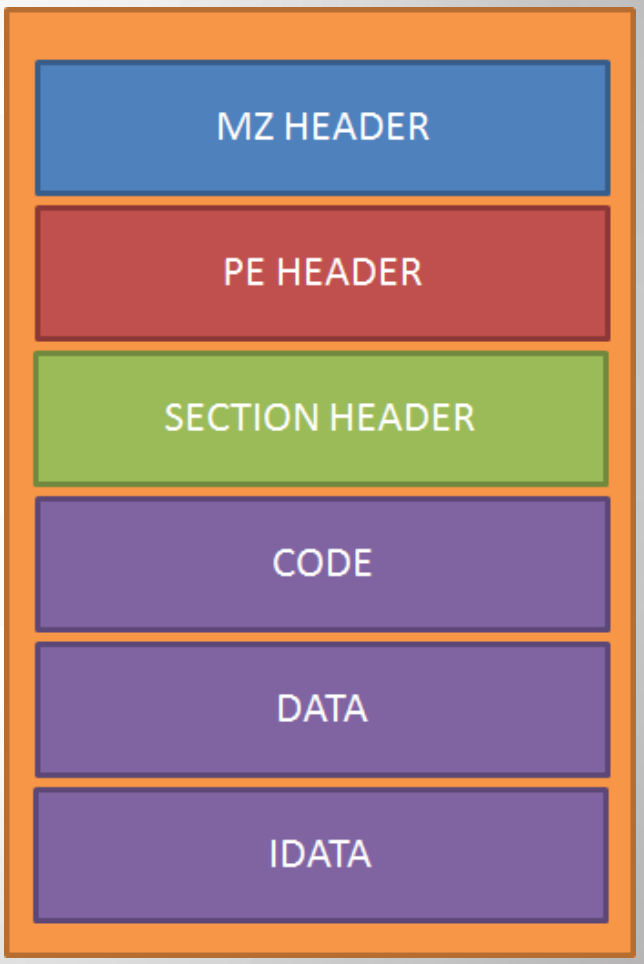
DATA Section

```
.00403000:  00 00 00 00-00 00 00 00-00 00 00 00-4C 30 00 00                L0
.00403010:  3C 30 00 00-00 00 00 00-00 00 00 00-00 00 00 00   <0
.00403020:  59 30 00 00-44 30 00 00-00 00 00 00-00 00 00 00   Y0  D0
.00403030:  00 00 00 00-00 00 00 00-00 00 00 00-64 30 00 00                d0
.00403040:  00 00 00 00-72 30 00 00-00 00 00 00-4B 45 52 4E       r0      KERN
.00403050:  45 4C 33 32-2E 44 4C 4C-00 55 53 45-52 33 32 2E   EL32.DLL USER32.
.00403060:  44 4C 4C 00-00 00 45 78-69 74 50 72-6F 63 65 73   DLL   ExitProces
.00403070:  73 00 00 00-4D 65 73 73-61 67 65 42-6F 78 41 00   s   MessageBoxA
```

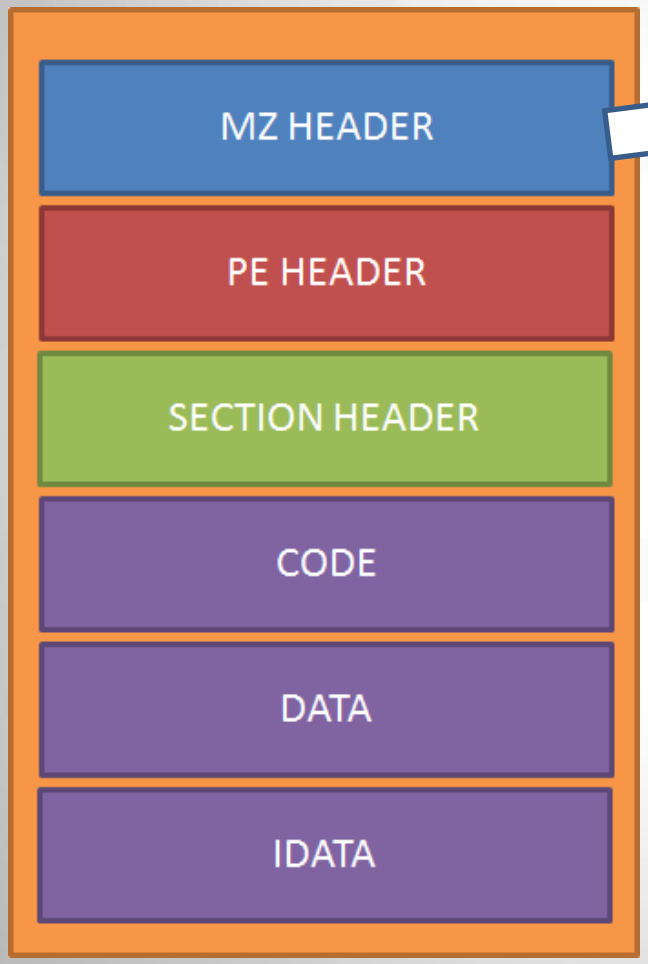
IDATA Section

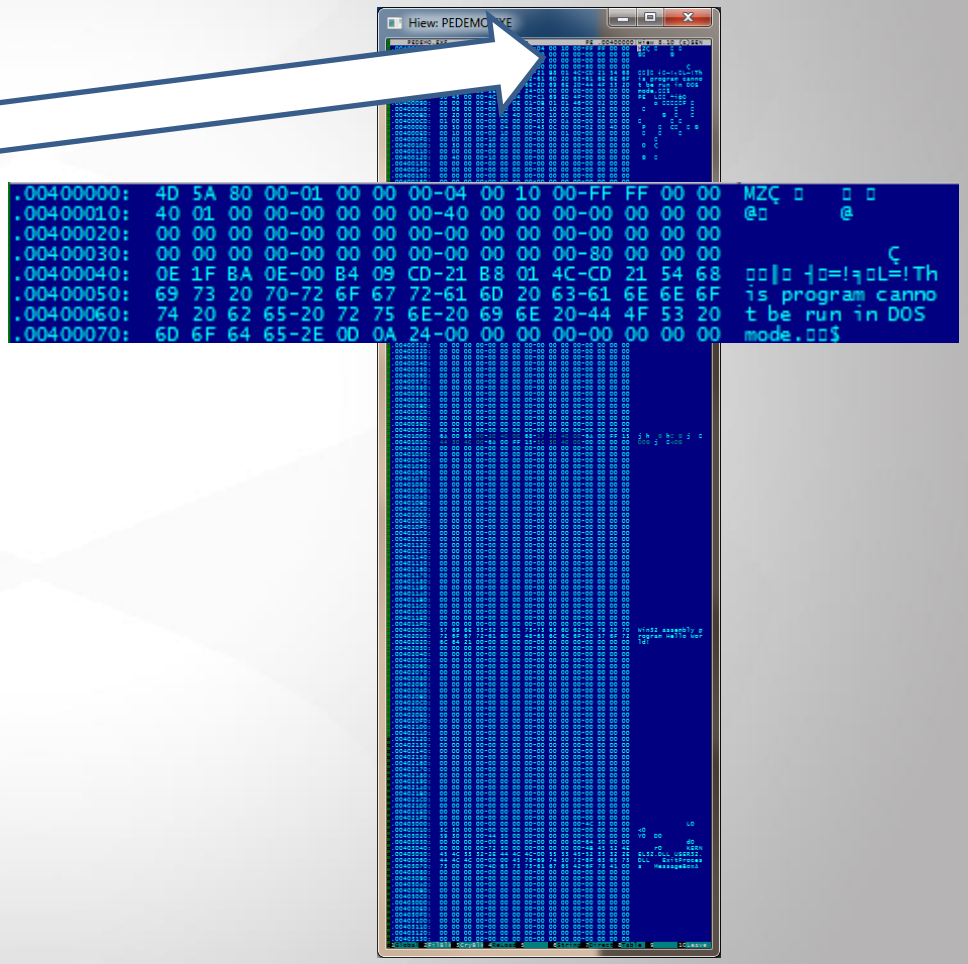
The EXE File

- EXE files are called Portable Executable files or PE file for short.
- PE format defines how a file should be structured to make it executable in Windows.
- SYS, DLL, OCX files are also PE files.



The EXE File





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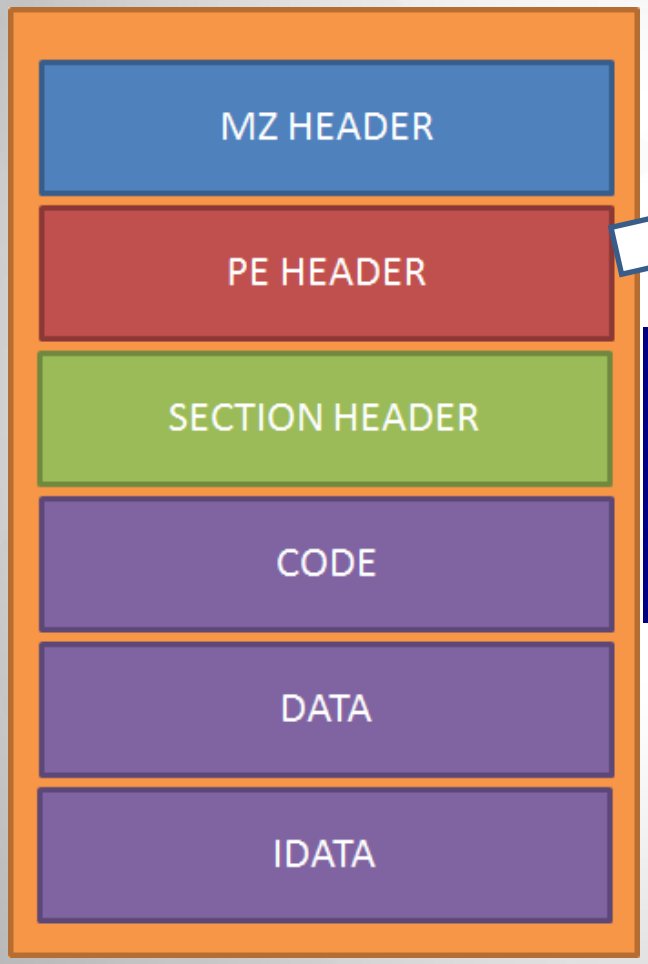
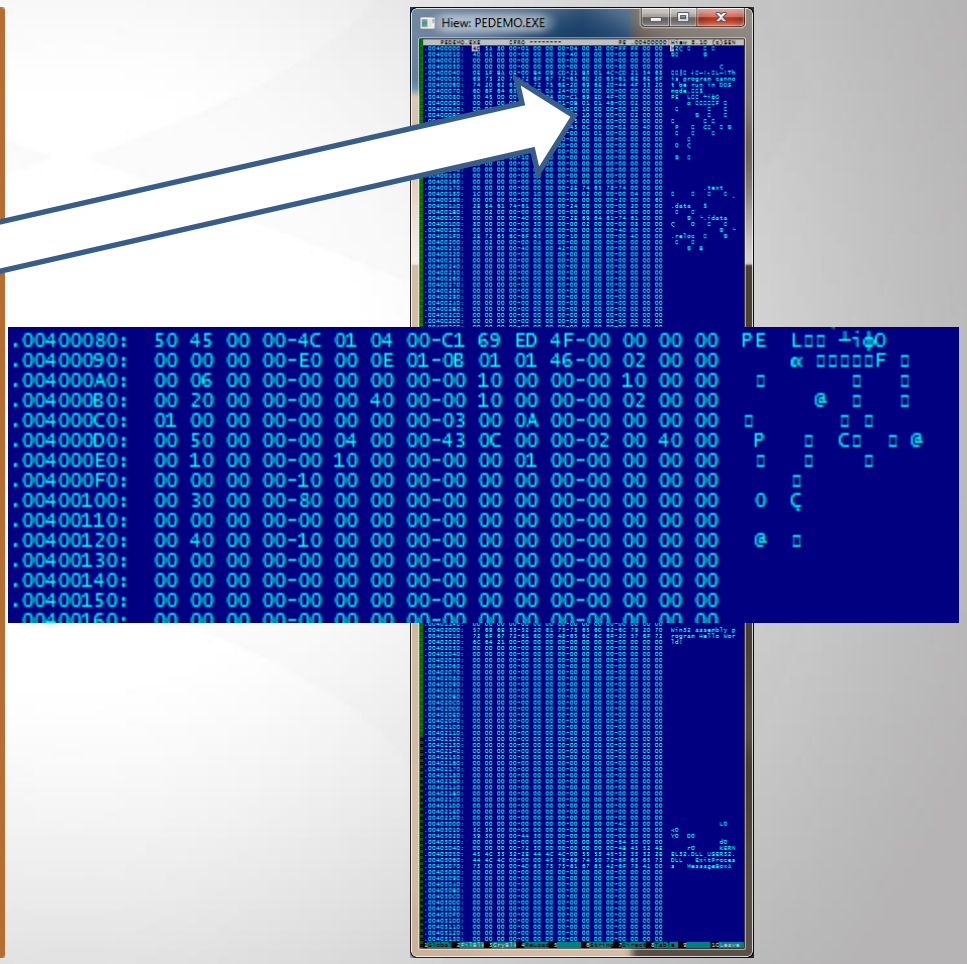
The EXE File





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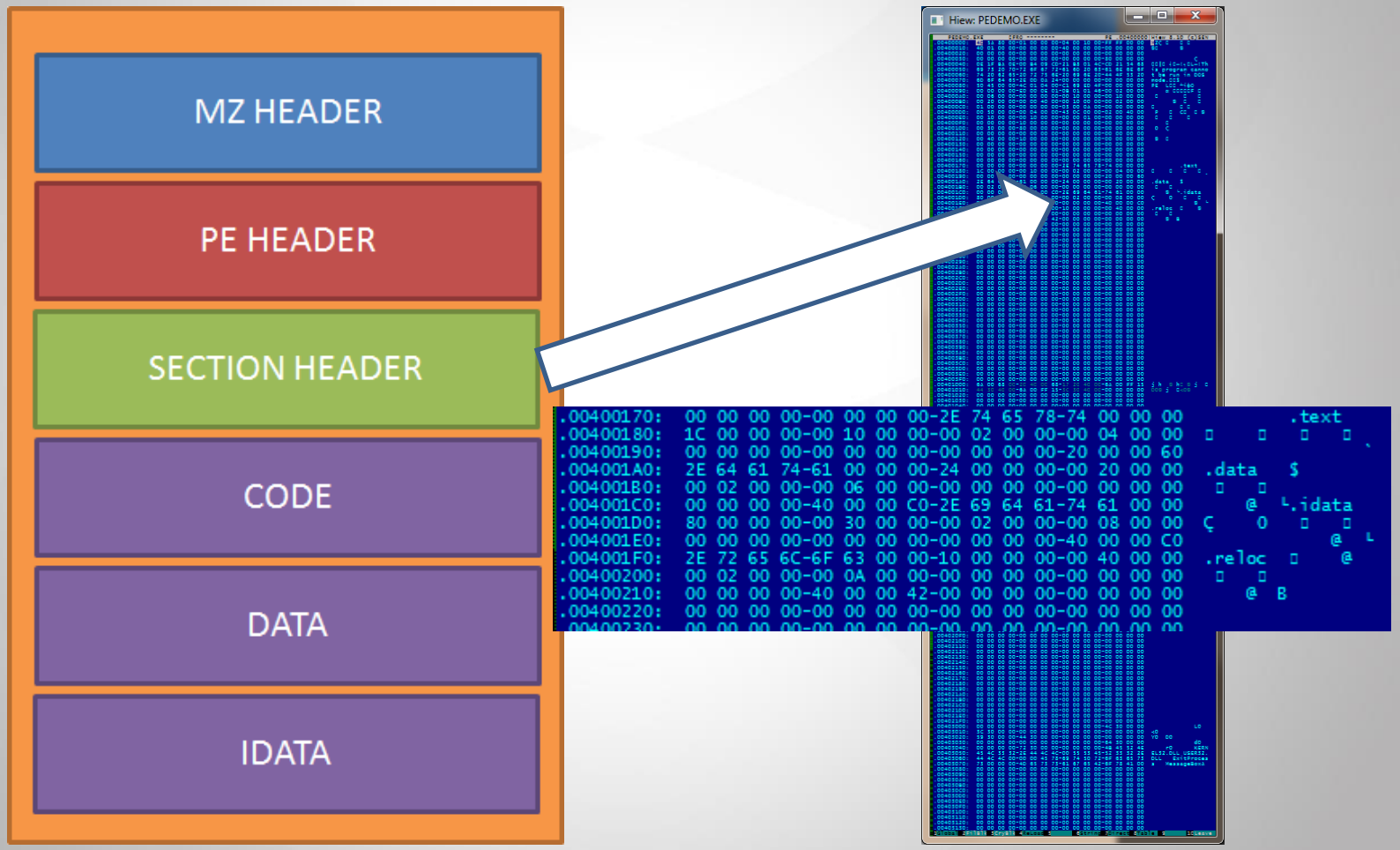
The EXE File



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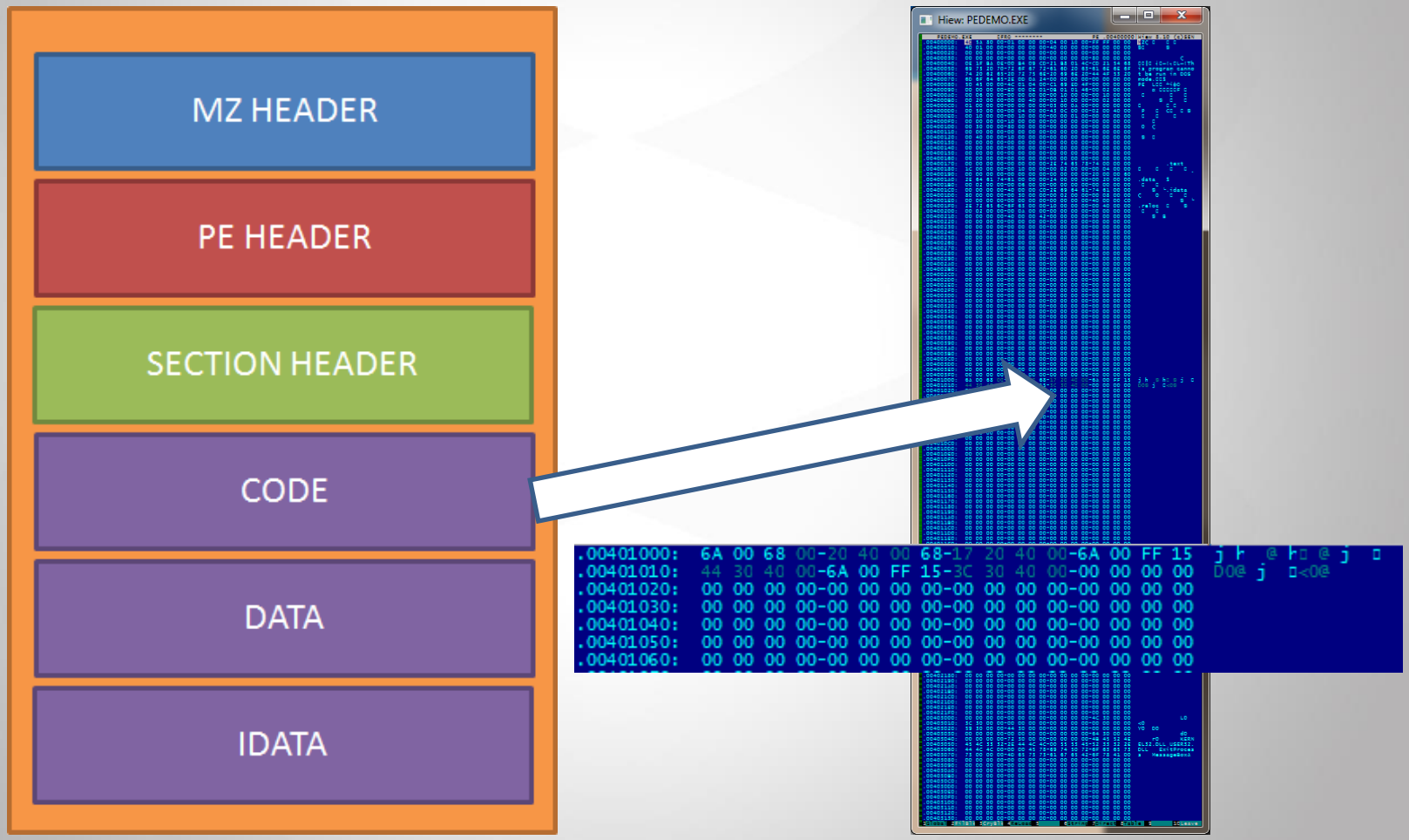
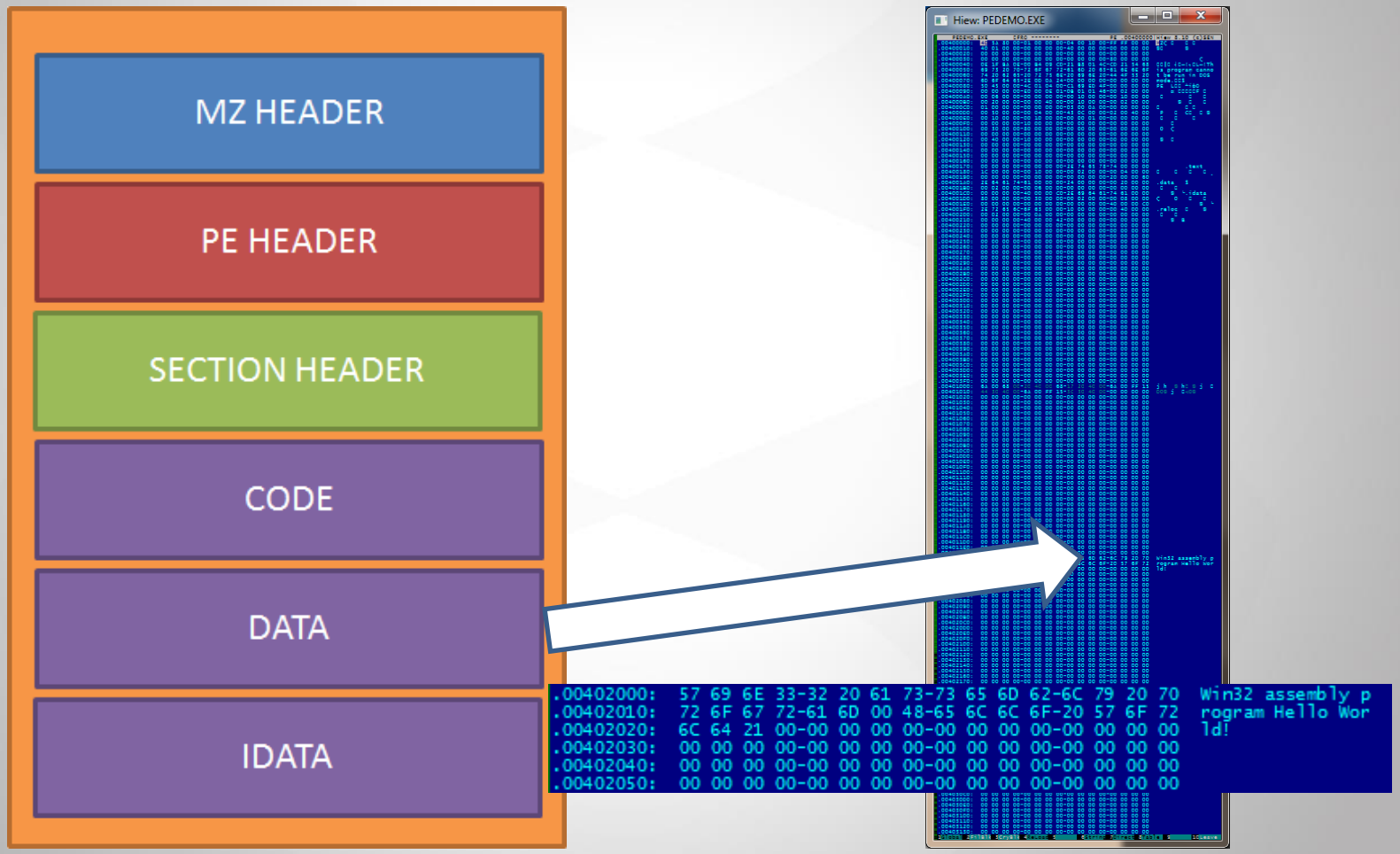
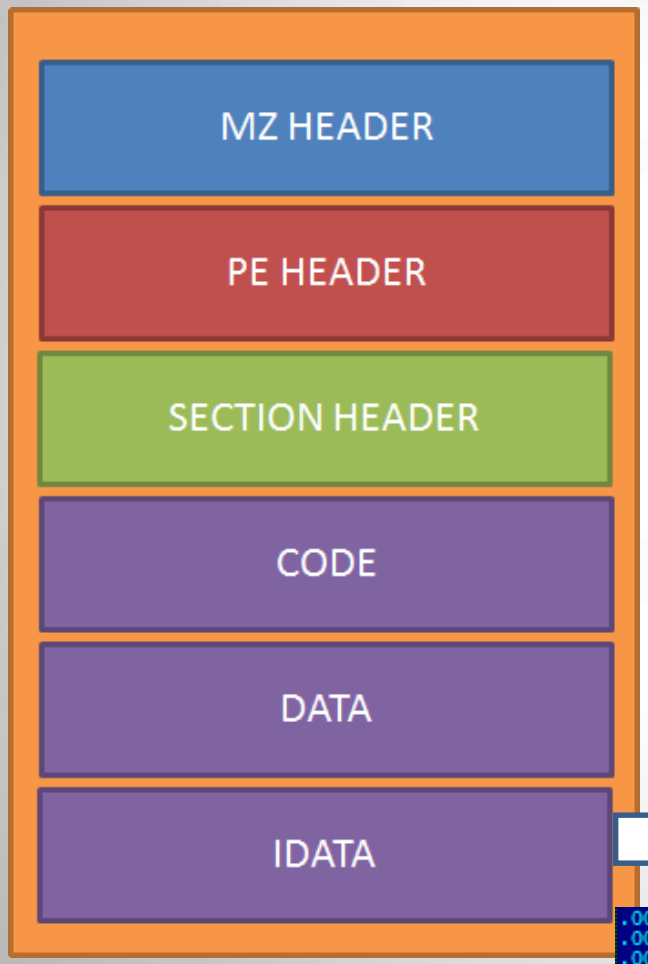
The EXE File

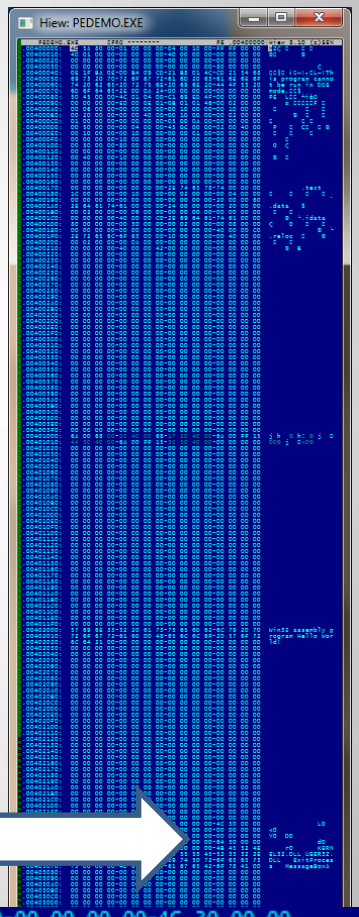

MZ HEADER
PE HEADER
SECTION HEADER
CODE
DATA
IDATA
Hiew: PEDEMO.EXE
.00401000: 6A 00 68 00-20 40 00 68-17 20 40 00-6A 00 FF 15
.00401010: 44 30 40 00-6A 00 FF 15-3C 30 40 00-00 00 00 00
.00401020: 00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
.00401030: 00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
.00401040: 00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
.00401050: 00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00
.00401060: 00 00 00 00-00 00 00 00-00 00 00 00-00 00 00 00

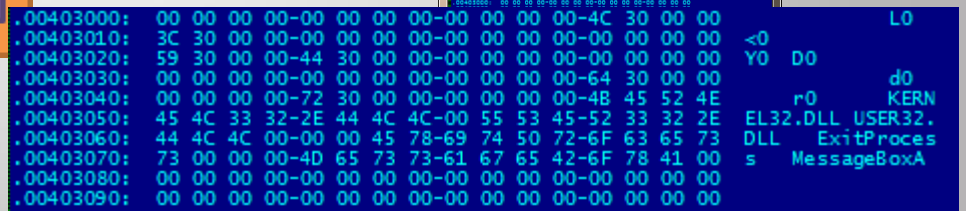
The EXE File



The EXE File







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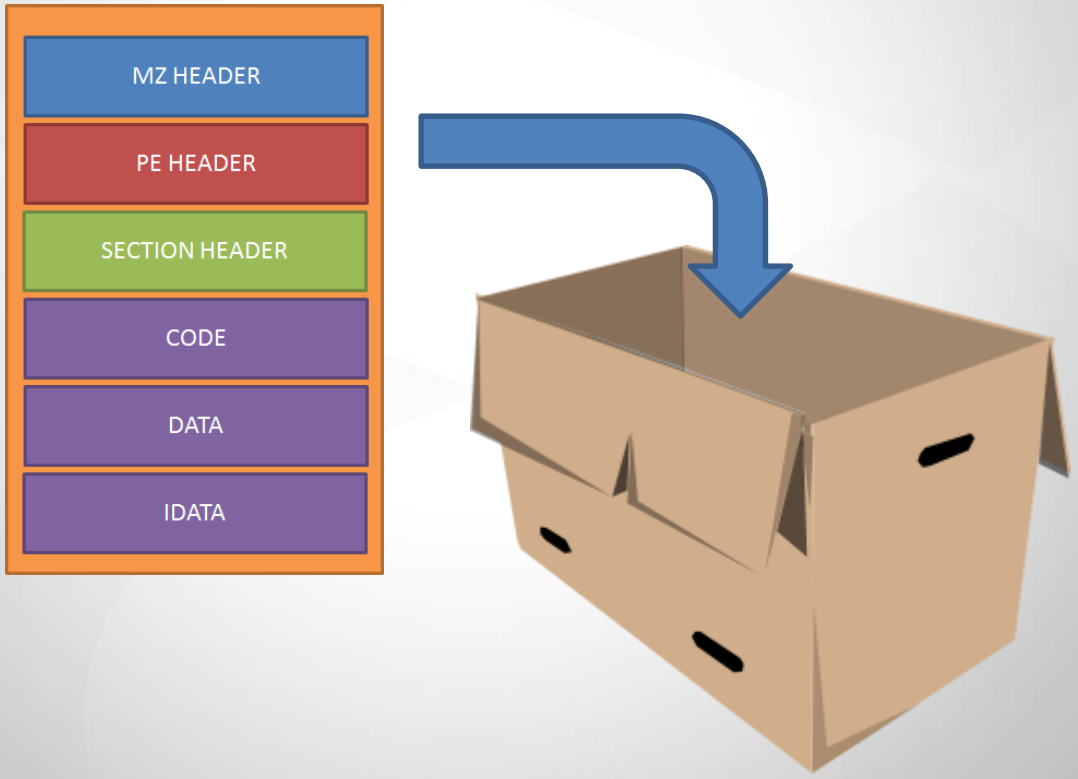
The EXE File



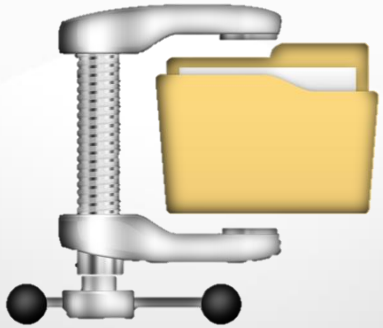
WHAT ARE PACKERS?

The PE Packer

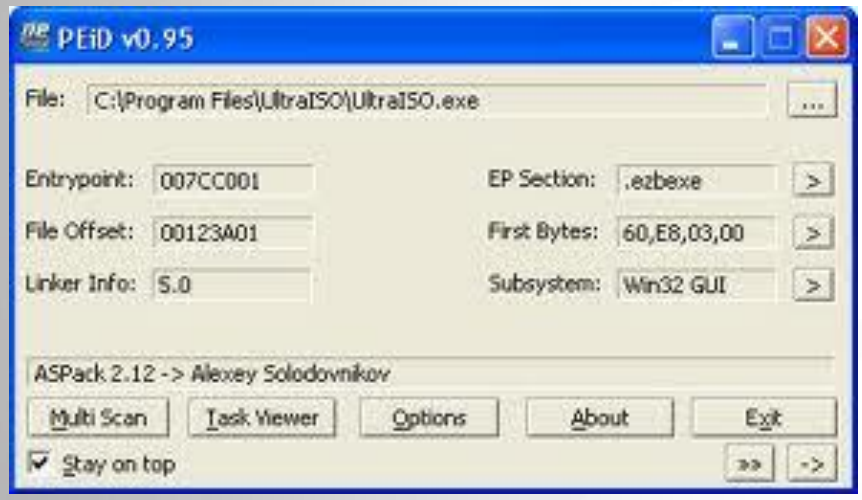
- Hides static codes from being inspected easily.
- Used by software companies to protect intellectual property.
- Used by malwares to avoid signature based detection.

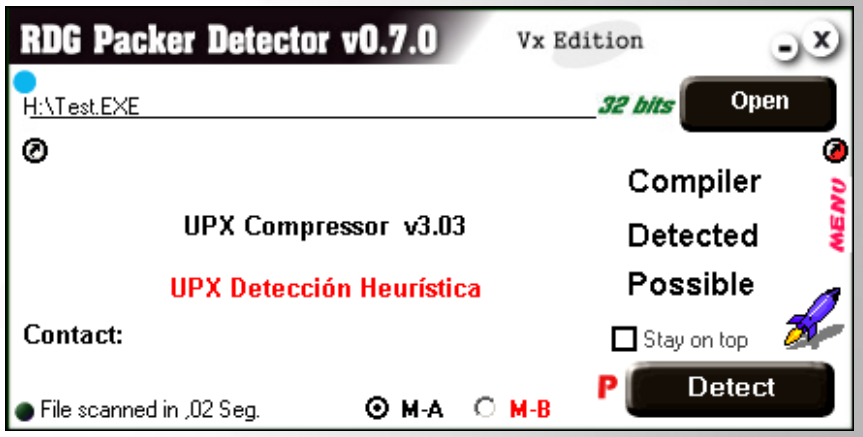
Types of Packer

1. Crypters – Uses keys to encrypt code and data.
2. Compressors – Uses compression algorithms to shrink code and data.
3. Protectors – Uses anti-debugging tricks to frustrate reversing.



Packer Detection





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CREATING AN UNPACKER

When to Unpack?

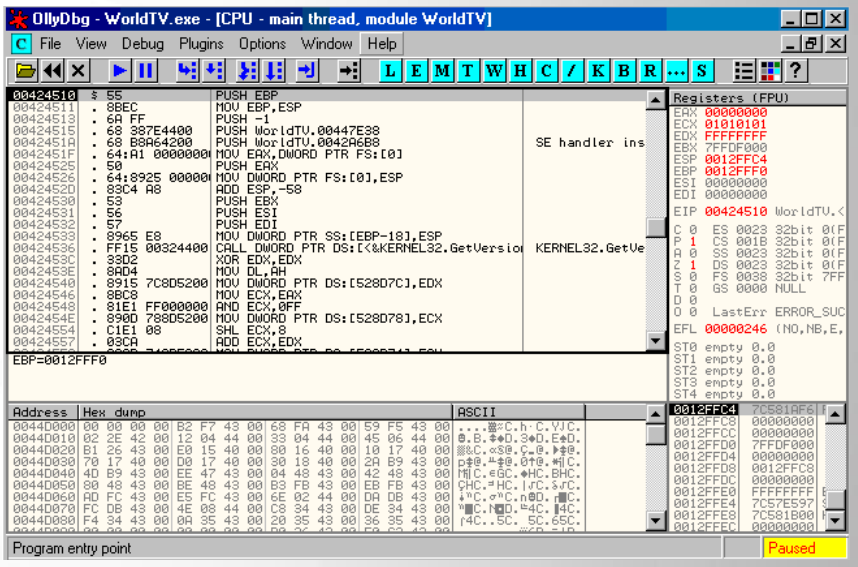
1. When a packer is used to defeat existing detection.
2. When a number samples from different malware families has a common packer stub.
3. When there’s a downloadable packer tool to create samples for testing.

What are Unpackers?

- Standalone applications, scripts, or add-on modules to a debugger or AV product.
- Restores code and data back to its original form.
- Expose code structure and strings for static analysis.

Unpacking Tools

- OllyDbg
  - OllyScript plugin
  - OllyDmp plugin
- Imprec
- LordPE



TitanMist

1. Open source
2. Based on OllyScript
3. LUA and Python supported
4. Created by ReversingLabs

TITANMIST DEMO

TitanMist Demo

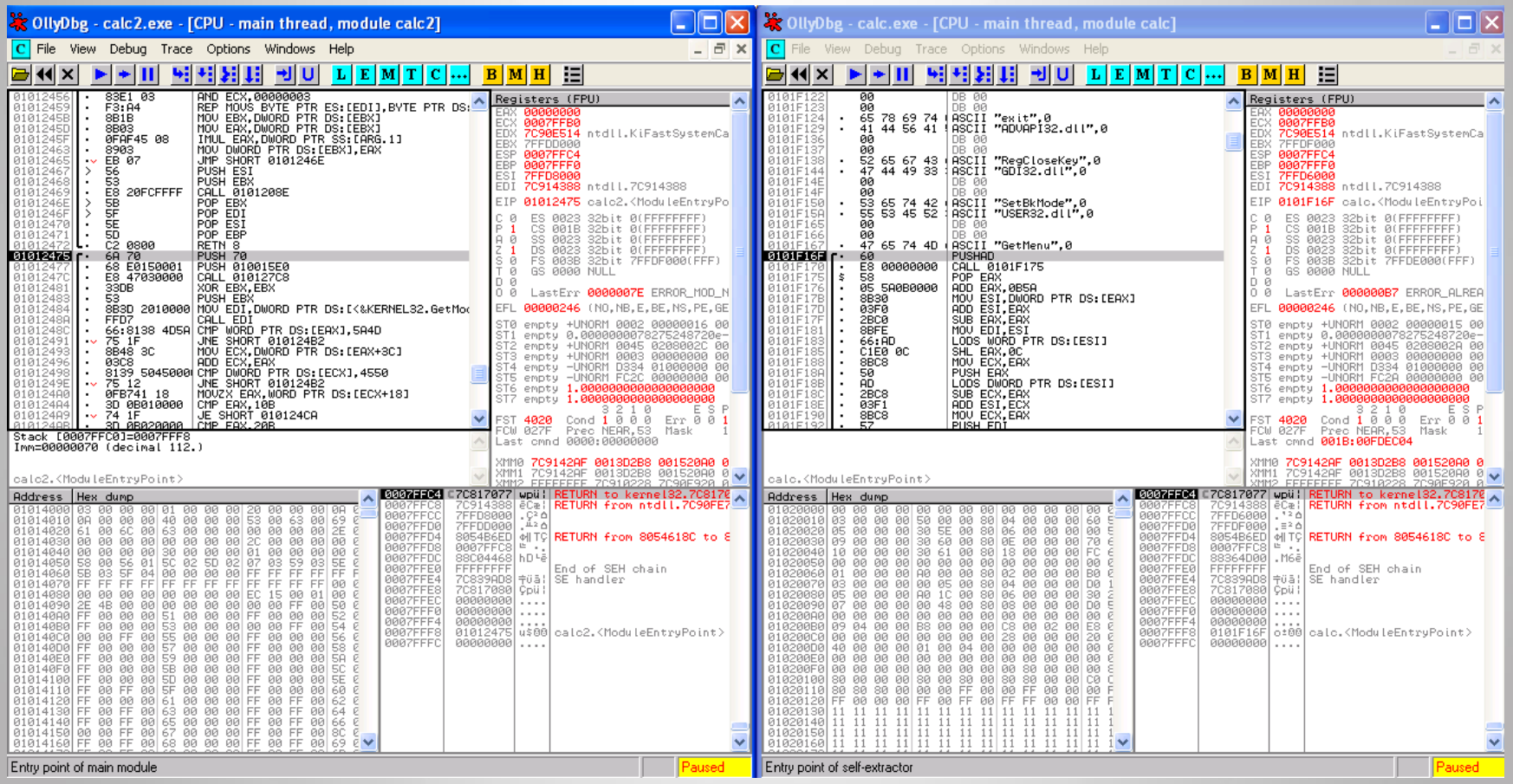
1. Python 2.7 (http://www.python.org/ftp/python/2.7/python-2.7.msi)
2. TitanMist 2.0 (http://www.reversinglabs.com/download/TitanMist.rar)
3. OllyDbg 2.0 (http://www.ollydbg.de/odbg200.zip)
4. MPRESS 2.17 packer (http://www.softpedia.com/get/Programming/Packers-Crypters-Protectors/MPRESS.shtml)
5. Host File: Win XP calc.exe (C:\Windows\System32\calc.exe)

TitanMist Demo

C:\WINDOWS\system32\cmd.exe

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\TitanMist>mpress.exe calc.exe

          MATCODE comPRESSor for executables
   Copyright (C) 2007-2010, MATCODE Software, MPRESS v2.17

<< calc.exe >>
PE32/x86 112.0kB -> 55.0kB  Ratio: 49.1%


C:\TitanMist>
```

TitanMist Demo



TitanMist Demo

db.xml - Notepad

File Edit Format View Help

```
                        89 85 ?? ?? ?? ?? 8B 85 ?? ?? ?? ?? 83 E0 01 74 48
                        8B FD 8D 85 ?? ?? ?? ?? 50 64 FF 35 ?? ?? ?? ?? 64
                        EB 01 FF CC 8B EF 64 8F 05 ?? ?? ?? ?? 83 C4 04 3C
                </signature>
                <signature start="ep" version="1.2">
                        60 E8 00 00 00 00 5D 81 ED ?? ?? ?? ?? B9 ?? ?? ??
                        ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ??
                        ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? AA E2 [7F-FF] -(1
                </signature>
                <signature start="ep" version="1.3">
                        55 8B EC 53 56 57 60 E8 00 00 00 00 5D 81 ED ?? ??
                        81 C2 ?? ?? ?? ?? 8D 3A 8B F7 33 C0 EB 04 90 EB 01
                        ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ??
                        ?? ?? ?? AA E2 [7F-FF] -(1) !(-2) AC
                </signature>
        </entry>
        <entry
                name="MPRESS"
                url="http://kbase.reversinglabs.com/index.php/Main_Page"
                description=""
                author="Matcode Software">
                <unpacker type="titanscript">
                        mpress.txt
                </unpacker>
                <signature start="ep" version="2.17">
                        60 E8 00 00 00 00 58 05 ?? ?? ?? ?? 8B 30 03 F0
                        2B C0 8B FE 66 AD C1 E0 0C 8B C8 50 AD 2B C8 03
                        F1 8B C8 57 51 49 8A 44 39 06 88 04 31 75 F6
                </signature>
        </entry>
</mistdb>
```

TitanMist Demo

```
C:\WINDOWS\system32\cmd.exe

C:\TitanMist\TitanMist>TitanMist.exe -i C:\TitanMist\calc.exe
        TitanMist by ReversingLabs Corp.
 version  :          1.0

 Match found!
 Name:         MPRESS
 Version:      2.17
 Author:       Matcode Software
 Wiki url:     http://kbase.reversinglabs.com/index.php/Main_Page
 Description:

eip: 01012475
 Unpacking succeeded!

C:\TitanMist\TitanMist>
```

FINAL THOUGHTS

- Unpackers are needed while packers exist.
- Unpacking is a valuable skill for malware analysts to learn.
- Antivirus products need unpackers to prolong the effectiveness of their signatures.
- Next Gen AV need unpackers/signature based detection to filter out non-APT or in-the-wild samples.

QUESTIONS?

References

1. Craig, P. (2006). Unpacking Malware, Trojans and Worms
2. Talekar, N. (2012). Practical Reversing II – Unpacking EXE
3. Albertini, A. (2010). Packers
4. Damballa (2011). Next Generation Anti-Virus